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Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES — WORLDWIDE
APRIL 22, 1991

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Cover photograph: Ed Glendinning

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Teradata's conservative, almost anonymous way of doing business contrasts starkly with the razzle-dazzle on display at most rapidly growing companies. But CEO Kenneth Simonds has taken the Los Angeles-based computer maker to the top spot in this year's list of ELECTRONIC BUSINESS's 100 fastest-growing companies

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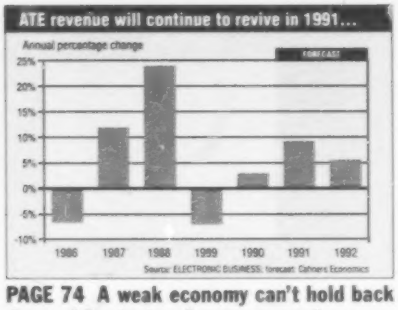

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Total Circulation: 77,804

REPRINTS

ELECTRONIC BUSINESS articles are available on a custom printing basis at reasonable prices. Contact Andrea Marwitz, Cahners Reprint Service, Cahners Plaza, 1350 E. Touhy Ave., P.O. Box 5080, Des Plaines, IL 60018 (708) 635-8800
Electronic Business can be purchased on 35mm microfilm through University Microfilm Int. Periodical Entry Dept., 300 Zeeb Road, Ann Arbor, MI 48106

What's in a name?

Funny how certain brand names become burned into the public consciousness over the years. When I was a kid, the rites of passage for any young male included a '55 Ford, ideally in pink and black. Chocolate was spelled H-E-R-S-H-E-Y. You kept your milk and eggs in the "Frigidaire," no matter who made it.

Tom McHale, executive editor of *Electronic Business Asia*

Today, the need for brand-name recognition has dawned on the South Korean electronics industry. As in Japan, Korean producers broke into electronics as suppliers of low-cost (and often low-quality) consumer products, which were then distributed under the logos of better-known manufacturers. By one estimate, these OEM sales now account for 70% to 80% of Korea's total electronics exports.

But in another analogy with Japan, Korea now feels compelled to start recouping its skyrocketing R&D and labor costs through higher value-added products, while at the same time earning some much-needed recognition. As Geoff Crane reports in this issue, Goldstar, Daewoo Electronics, and other Korean giants hope to meet those goals and cut their heavy dependence on OEM sales by pushing products under their own names. Their success, says Crane, will depend largely upon whether Korean designers can take yet another tip from Japan—this time by adding that special look and touch that magically sets one product apart from all the others on the shelf.

Crane's story also appeared in our sister publication, *Electronic Business Asia*, which celebrates its first anniversary next month. The Hong Kong-based magazine is Cahners Publishing's first foray into the Asian market, and in a sense it provides another lesson in creating name recognition in a key market.

What prompted Cahners to launch *Electronic Business Asia*? The reason, explains executive editor Tom McHale, is that Asia will represent the world's largest electronics market by the year 2000—$339 billion, compared with $325 billion for North America and $292 billion for Europe. No company can afford to ignore those numbers, says McHale. That's why *Electronic Business Asia* is not just an "Asian version" of a U.S. magazine: The magazine is written by its own staff of writers and correspondents throughout Asia and is pegged exclusively to 40,000 executives in Japan, Taiwan, Korea, and every other major Asian market.

Admittedly, *Electronic Business Asia* is not yet a Ford or a Hershey in terms of worldwide name recognition; that will take time, and a lot of grunt work by McHale and his staff. Meanwhile, we at ELECTRONIC BUSINESS are gratified that we can offer our readers this unique window on Asia, which is unmatched by any other U.S. electronics magazine.

H. GARRETT DeYOUNG, managing editor

ELECTRONIC BUSINESS® (ISSN 0163-6197, GST Reg. #123397457) is published twice a month, except monthly in December, by The Cahners Publishing Company, A Division of Reed Publishing USA, 275 Washington Street, Newton, MA 02158-1630. Terrence M. McDermott, President; Frank Sibley, Executive Vice President; Jerry D. Neth, Senior Vice President/Publishing Operations; J.J. Walsh, Senior Vice President/Finance; Thomas J. Dellamaria, Senior Vice President/Production and Manufacturing; Ralph Knupp, Vice President/Human Resources. ELECTRONIC BUSINESS® is a registered trademark of Reed Properties Inc., used under license. Circulation records are maintained at Cahners Publishing Company, 44 Cook Street, Denver, CO 80206-5800. Telephone: (303)388-4511. Second-class postage paid at Denver, CO 80206-5800 and additional mailing offices. **POSTMASTER:** Send address corrections to ELECTRONIC BUSINESS®, PO Box 173377, Denver, CO 80217-3377. ELECTRONIC BUSINESS® copyright 1991 by Reed Publishing USA; Ronald G. Segel, Chairman and Chief Executive Officer; Robert L. Krakoff, President and Chief Operating Officer; William M. Platt, Senior Vice President. Annual subscription rates for non-qualified people: USA, $84.95; Canada, $124.95; other countries, $149.95 per year; $140, air mail surcharge. Subscriptions include all issues. Except for special issues where price changes are indicated, single copies are available for $15.00 (USA, Canada/Mexico and foreign). Please address all subscription mail to Eric Schmierer, 44 Cook Street, Denver, CO 80206-5800. Cahners Publishing Company, A Division of Reed Publishing USA • Specialized Business Magazines for Building & Construction • Research • Technology • Electronics • Computing • Printing • Publishing • Health Care • Foodservice • Packaging • Environmental Engineering • Manufacturing • Entertainment • Home Furnishings • Interior Design. Specialized Consumer Magazines for Child Care • Boating • Wedding Planning.

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EMPLOYMENT

Electronics employment figures drop

TOTAL U.S. ELECTRONICS employment in 1989 was 2.58 million workers, 20,000 fewer workers than 1988. But even though overall employment was down, states such as Texas and Washington—both of which have actively been trying to attract high-tech companies—were winners. Electronics includes equipment and software manufacturers.

ELIZABETH BAATZ

Chang[illegible]tronics em[illegible]

(thousands of workers, 198[illegible])

Where employees left ...		... and where they w[illegible]	
California	-19	Texas	+6
Massachusetts	-13	Washington	+4
New York	-6	Tennessee	+3
Pennsylvania	-6	North Carolina	+3
Arizona	-5	Colorado	+3
Connecticut	-4	Michigan	+3
New Jersey	-3	Mississippi	+3
Utah	-3	Oregon	+3

Source: American Electronics Association

loophole has allowed such satellites as Astra, owned by the Luxembourg-based Societe Europeene des Satellites (SES), to circumvent the ruling by transmitting on the PAL system, Europe's most popular broadcast standard.

The Astra-supplied programs were an almost immediate success. While only 100,000 European TV viewers receive MAC programs via Direct Broadcast System satellites, about 2.5 million receive PAL programs directly from such medium-powered satellites as Astra, according to Astra marketing director Koen Van Driel. He predicts that by the end of the decade, the relatively cheap 60-cm satellite dish required for Astra reception will be installed in 77 million residences—66% of all European homes.

"You can't impose choices on the consumer," asserts Pierre Meyrat, SES's managing director. He fears tighter MAC restrictions would put the fledgling company out of business and warns of the potential damage in developing a competitive pan-European audiovisual market if MAC is imposed. The pro-MAC faction risks seeing billions of investment dollars wasted if the single MAC standard is scrapped.

LINDA BERNIER

CONSUMER ELECTRONICS

Home shoppers rejoice: Here's interactive TV

IF YOU THOUGHT technology had reached its capacity for squelching human get-up-and-go in the name of convenience, think again. When interactive television ("interactive video service" in Federal Communications Commission parlance) hits the airwaves later this year, couch potatoes won't even have to dial that 800 number to do their home shopping.

On Jan. 10, the FCC issued a notice of proposed rule making—generally a sure sign of acceptance once the requisite comment periods and technical tinkering have taken place—to allocate half a megahertz of broadcast spectrum space to such services. That is roughly the equivalent of one-sixth of a broadcast television channel.

The service under consideration will allow viewers to bring up an order form during an advertisement with just the click of a remote control. TV Answer Inc. of Reston, Va., the developer and prime lobbyist for the technology, reports enthusiasm from advertisers, who love the immediate, computer-to-computer transaction processing. Broadcasters also have a stake, as the service could put the reins on channel-hopping during ads.

There are non-commercial uses as well. Colleges will be able to offer televised courses complete with exams, news organizations will be able to poll hundreds of thousands of people in virtual real time without having to bother them on the phone, and—maybe best yet—VCR manufacturers will be able to offer on-screen fill-in-the-blank programming for those millions who still haven't figured out their instruction manuals.

But TV Answer probably loves it the most. The company has spent $20 million and 10 years developing the basic technology under consideration, which is actually more like cellular telephone than television. In the system, transmission stations located in cells throughout the nation—each serving about 10,000 households—receive information to be broadcast from company headquarters via satellite. The programming is then converted into radio signals and transmitted to VCR-like computers that sit atop subscribers' TV sets. Although the FCC has spurned TV Answer's bid for a nationwide license (they propose a local bidding process in which available spectrum is divided to enable competition in every cell), the company expects to be installed in 62 million homes by the year 2000.

PETER BURROWS

WORKSTATIONS

IBM: no longer the workstation weakling

IBM IS NOT getting too cocky about the success of its RISC System/6000 workstation—at least not yet.

Despite the phenomenal success of the RS/6000 line since its February 1990 introduction and IBM's aggressive goals for workstation market share, company executives are cautioning analysts against overly optimistic predictions for RS/6000 sales this year. IBM pushed a lot of the workstations out the door in late 1990—10,000 units in December alone—in order to meet pent-up demand. But while some industry watchers have extrapolated that sales rate into 1991, IBM is more cautious.

"I think some of the projections extending [the late 1990 sales] out into the $2 billion to $3 billion range for 1991 are a bit too aggressive," said Bill Filip, IBM vice president and president of the Advanced Workstations Division, during the March introduction of additions to the RS/6000 line. IBM is hinting at 1991 sales figures in the range of $1.7 billion to $2 billion.

Nevertheless, after years of failure with the feeble RT, the RS/6000's predecessor, IBM is not above trumpeting its success. Filip claimed that IBM sold 25,000 RS/6000 workstations and servers last year, generating $1 billion in sales. (Because that includes software, peripherals, and other products, plus RS/6000 systems used as midrange multiuser computers, Dataquest puts IBM's workstation sales at $366 million for a 5% share of the $7.35 billion 1990 worldwide workstation market.) This year IBM is aiming for double-digit market share, according to Filip, and has its sights on becoming the leading workstation vendor by 1993.

Last month the company unveiled the 320H PowerStation addition to the RS/6000 line, boasting a 25-megahertz RISC chip that offers 11.7 MFLOPS (millions of floating point operations per second) of speed. Also introduced was a high-end server system and options to improve RS/6000 storage capability and graphics performance. Filip hinted that a low-end addition to the RS/6000 family will be released later this year.

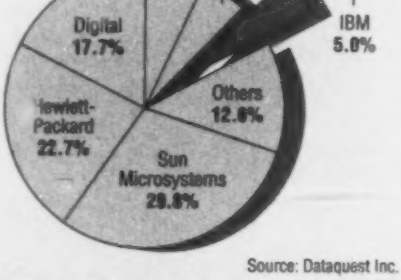
There also are signs that IBM is becoming more price competitive. A price list in the 320H PowerStation press kit put the cost of a sample configuration of the workstation at $20,501. A last-minute handout at the press conference listed the same configuration at $17,972. Journalists were told to ignore the old release.

RICK WHITING

IBM: finally a workstation player

Worldwide 1990 workstation market share based on factory revenue

(Total 1990 revenues = $7.36 billion)



Source: Dataquest Inc.

DISK ARRAYS

RAIDing the market with an old idea

FOR YEARS, disk-drive vendors have been trying to pry open a market for disk-array systems, and it appears that with help from systems vendors, the market now may indeed be opening up.

Disk arrays are storage subsystems composed of a handful of small form factor disk drives. They are strung together with the intent of improving not only capacity and performance, but integrity of the data through fault-tolerant storage techniques. There are five levels of array capability measured by so-called RAID standards—literally, a redundant array of inexpensive disks. Arrays at the RAID-3 level boost data integrity through mirroring data across the array, or having more than one disk with the same data in the event a drive breaks. RAID-5 drives improve performance and integrity through data striping.

Compaq Computer Corp. gave a booster of legitimacy to the disk-array market last year upon introducing a RAID-5 array option with its SystemPro line. At the Comdex trade show in November, Micropolis Corp., one of the first disk-drive vendors to push an array (it had a meager marketing effort in the early 1980s), also introduced a modular software-based RAID-5 array of five 5.25-inch drives. More recently, Data General offered a disk-array option with its new Aviion Unix servers (see related story).

At about the same time, Comdex, NCR Corp., and Seagate Technology Inc. announced a joint development of a RAID-5 subsystem, and NCR is now on the march to market array controllers and subsystems to a number of major system OEMs. NCR is already shipping a five-disk array of 200 megabyte Seagate drives that it says is in hot demand by database and on-line transaction processing customers who can't afford mainframe DASD-type storage. Storage Technology Corp. also has an array program and IBM has been shipping RAID arrays as an option with its systems. A 2-gigabyte RAID-5 disk array can cost as little as $1,500, compared with an 8-inch form factor

Teradata's low-profile road to a high growth rate

Conservative yet entrepreneurial, the computer maker tops ELECTRONIC BUSINESS's list of the 100 fastest-growing U.S. electronics companies

Financial analysis for this year's report was provided by senior editors Elizabeth Baatz and Linda Stallmann. The five runner-up companies (each with a five-year compounded average annual growth rate of 100% or more) are profiled by associate editor Dave Webb.

BY RICK WHITING

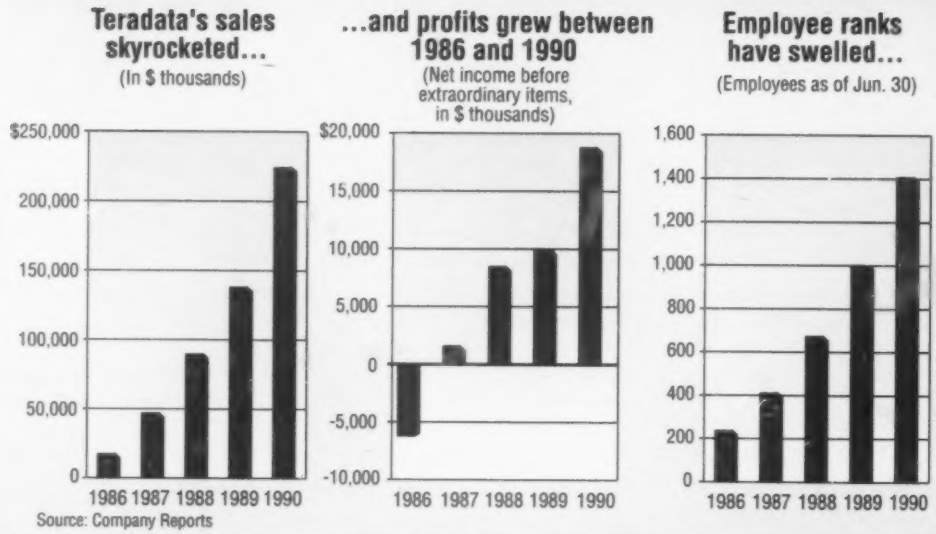
If you spend much time studying fast-growing technology companies, you'll quickly conclude that many of the companies become as famous for their glitz, cockiness, and brash management styles as for their bottom-line performance. In workstations, for example, Sun Microsystems' Scott McNealy comes almost immediately to mind; in the chip world, it has to be Cypress Semiconductor's T. J. Rodgers.

Then there's Teradata Corp. Until recently, the Los Angeles-based company was almost as faceless as its products—powerful but unglamorous computers that generally chug quietly away in a back room, virtually out of sight and out of mind. At one time, some outsiders even thought that Teradata was in the earth-moving business because of its ambiguous name. (The name actually comes from the computers' ability to store and manipulate trillions of bytes—"terabytes"—of data.)

But Teradata has shucked its obscurity once and for all. The company was named *Inc.* magazine's fastest-growing small public company in 1989 and has achieved a compounded average annual growth rate (CAAGR) of 140% in the last five years. Sales last year hit $224.2 million. That puts Teradata at the top of ELECTRONIC BUSINESS's list of the 100 fastest-growing U.S. electronics companies, joining an exclusive club of companies with five-year CAAGRs of more than 100%.

Teradata's low profile still sets it well apart from Sun Microsystems and Cypress Semiconductor, which copped the ELECTRONIC BUSINESS award in 1989 and 1990, respectively. Despite a customer list made up almost exclusively of *Fortune* 200 companies, Teradata's success has come without the razzle-dazzle typical of so many fast-growing companies. Rather, Teradata executives and customers, as well as industry analysts, claim that the company has done so well because it has the right product for the right market: parallel-processing computers that sort and

Teradata's quiet climb to the top



Source: Company Reports

compile blocks of information that are too voluminous even for mainframes from IBM and other vendors.

The TransAmerica Insurance Group, for example, relies on its Teradata system to process massive volumes of information about insurance accounts and claims histories and to track the performance of its 5,000 agents. K Mart Corp. improved its Christmas shopping season profits last year when its Teradata computer, sorting through sales and inventory data, picked hot-selling items in time for store managers to reorder. Consumer products companies such as Helene Curtis Industries Inc. and Procter & Gamble Co. also use Teradata computers to monitor sales and inventories. And as these and other corporations increasingly rely on computers to store large amounts of data, it seems certain that Teradata's market will also increase.

Still, all is not roses for Teradata. The company's rapid expansion was interrupted during its first fiscal 1991 quarter last fall because of weakness in several key markets. With an average price tag of $1.3 million, Teradata computers are big-ticket purchases that customers may opt to delay in the midst of a recession, notes Kenneth W. Simonds, chairman, chief executive, and president. The company also has just introduced its DBC/1012 Model 4, based on Intel Corp.'s 80486 chip, and product transitions are always dicey for fast-growing companies.

Founded by employees of Citicorp subsidiary Transaction Technology Inc. and Xerox Corp., Teradata was slow getting out of the gate. The company's first product, the 8086 chip-based DBC/1012 Model 1, wasn't shipped until 1984 and proved to be underpowered for its assigned tasks. And because parallel-processing and relational database computing were new concepts at the time, market acceptance for Teradata's products was slow in coming. Sales began to pick up in 1985 and accelerated in 1986 with the introduction of the company's second-generation product, the 80286-based DBC/1012 Model 2.

Today, the capabilities of the company's computers allow Teradata to occupy a niche all by itself. "You've got to start with the product. That's clearly the cornerstone," says Donald C. Cantor, chief operating officer and executive vice president of operations. True, Tandem Computers Inc. and Sequent Computer Systems Inc. are boosting the power and database capacity of their computers to make a run at Teradata's market, and IBM mainframes are an alternative for prospective Teradata customers. But for the moment, at least, Teradata's claims of having no real competition is more reality than marketing hype.

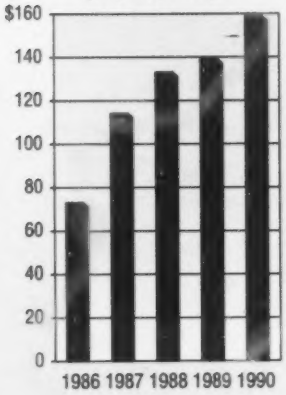
But Teradata managers claim that there's more to the company than simply good technology—there's also what Simonds calls an entrepreneurial environment and a willingness to take risks, but without the "free-wheeling" attitude of so many other companies with stratospheric growth rates. "The challenge," he says, "is to avoid getting too stodgy or bureaucratic."

Teradata maintains its startup spirit by organizing itself into small entrepreneurial business units, each

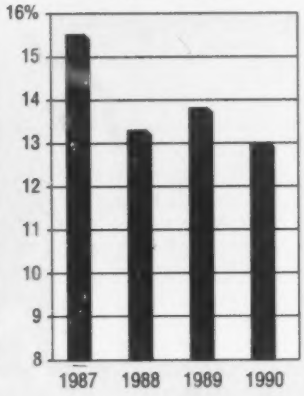
Teradata CEO Kenneth Simonds: "The challenge is to avoid getting too stodgy or bureaucratic"

Ed Glendinning

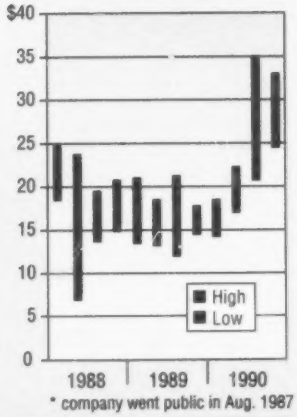
...while revenue per year-end employee has grown...
(in $ thousands)



...and R&D expenditures have held steady
(R & D expenses as a percentage of sales)



Stock prices* have been mixed
(High and low stock prices during fiscal year)



* company went public in Aug. 1987

focusing on such specific areas as Unix development, professional services, and networking products. The company also operates the Teradata Advanced Concepts Laboratory, which develops prototype products using leading-edge technology, and provides an avenue for employees to introduce ideas for new products or technologies.

Teradata's culture of entrepreneurship and customer focus is instilled into new employees through education and training, "weaving them into the fabric of the company," as Simonds describes it. Most Teradata workers have a stake in the company's growth: A full 80% are also stockholders.

Management-employee communications play a critical role in empowering employees to help define the company's direction. Each month the CEO and COO meet separately with workers, chosen at random from various departments, to make company announcements and take questions. The routine is repeated at quarterly companywide "roundup" meetings.

Keeping up with the company's fast-moving infrastructure hasn't been easy. Last year Teradata moved from the Marina del Rey section of Los Angeles into a high-rise in El Segundo, just south of Los Angeles International Airport. A new manufacturing facility in Dublin, Ireland, now augments the company's Los Angeles plant. To keep up with the company's accounting and billing operations, senior vice president of finance and administration Michael F. G. Ashby is in the process of overhauling Teradata's financial data-processing system—which includes three Teradata computers.

Teradata at a glance

Annual data	1990	1989
Sales (thousands)	$224,266	$137,411
Net income (thousands)	$18,758	$9,904
Net income/ sales	8.4%	7.2%
Cost of sales/sales	38.8%	36.9%
R&D/sales	13.0%	13.8%
Marketing, G&A/sales	32.5%	35.9%
Number of employees	1,406	1,001
Sales per employee	$159,464	$137,274
Net income per employee	$13,341	$9,894
Capital expenditures/sales	15.3%	14.1%
Current ratio	2.70	2.60
Debt/equity ratio	0.15	0.16
Foreign sales/sales	24.4%	29.2%

All figures for fiscal year ended June 30

Quarterly data	1990	1989
Sales (thousands)	$111,220	$97,586
Net income (thousands)	$ (7,175)	$6,460

Information for 6 months ended December 31

Source: Company reports

Keeping the spirit

But the biggest challenge for the company's managers is to maintain Teradata's explosive growth rate while keeping its entrepreneurial culture intact. Simonds's ambitious goal is to reach $1 billion a year in the mid-1990s and possibly $3 billion by the year 2000. Employment, which stood at 130 five years ago, now stands at 1,500, with about 100 employees being added each quarter.

Teradata's management team is a mix of the old and the new, although many of the top positions are held by people who came aboard after the company was established. Simonds, for example, joined Teradata in 1984, Cantor in 1986. Co-founder Jack E. Shemer remains as vice chairman while Jerold R. Modes, who also helped found the company, serves as senior vice president of strategic business operations. Co-founder Philip Neches left in 1988 to become senior vice president and chief scientific officer at NCR Corp.

Simonds came to Teradata after a 10-year stint at Amdahl Corp. where he was executive vice president. An amiable, self-assured Tennessean whose office is decorated with black-and-white nature photos by Ansel Adams, he also had spent 18 years at IBM in a variety of sales, sales management, and technical management posts. He joined Teradata as president and chief operating officer under Shemer and then shared the office of chief executive for just over a year before becoming CEO in December 1986.

"My experience at Amdahl was invaluable," he says, noting that he joined the mainframe vendor at approximately the same stage of growth as Teradata was when he joined it. And because many of Teradata's customers are also IBM accounts, Simonds's years with Big Blue are proving equally valuable.

Cantor joined Teradata as vice president of U.S. field operations and worked his way up through senior and executive vice president. Along the way he assumed responsibility for sales, marketing, customer service, manufacturing, corporate administration, and R&D. He was appointed chief operating officer last August.

Although his education is in technical engineering, Cantor's resume is similar to Simonds's—six years at IBM, "which gave me a good feel for the customer," he says, and eight years with Amdahl, "which gave me a good perspective on how to compete with IBM." He adds that two years at software start-up Intellistor Corp. "provided experience in everything from opening new markets in Europe to unstopping toilets."

Back on track

It was probably inevitable that the recession and the U.S. banking crisis would eventually show up on Teradata's doorstep. Slow sales in the U.K. (which accounts for 60% of the company's European sales) and decreased orders from the U.S. banking industry dragged down the first quarter's performance. Sales for the period were $47.4 million—up only slightly from $42.9 million a year earlier—and the company reported a net loss of $7.6 million. As a result, Teradata's stock price over the last 12 months has oscillated between $35.50 and $6.75. (The company went public in August 1987 at $20.)

Management acted quickly to maintain Teradata's profitability, reducing expenses and cutting about 200 workers from the payroll. Sales rebounded in the second quarter (ended Dec. 31) to $63.8 million, up from $54.6 million in the same period one year ago, and the company turned a $436,000 profit. The second-quarter results included $9.5 million in revenue from ShareBase

Corp., which Teradata acquired in June 1990.

Teradata watchers say the company is back on track, but that management must keep expenses from outpacing sales. Cantor says the company has resumed hiring, for example, but more selectively.

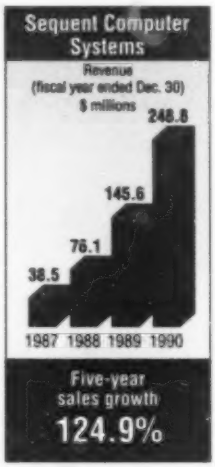
With perhaps a hint of relief, Teradata's executives now project that the company's annual growth rate will slow to 20% to 40% in the next two to three years. That somewhat more manageable pace should help Teradata pull off what Simonds describes as the company's most pressing task: to maintain the start-up spirit that has allowed Teradata to quietly, all but anonymously, carve out its own unique niche. □

Meet the runners-up

Sequent Computer Systems Inc.
Beaverton, Ore.

2

For a company looking to butt heads with the likes of IBM in the mainframe world by relying on machines built with standard PC microprocessors, Sequent has done remarkably well. The maker of so-called symmetric multiprocessing computers—boxes with up to 30 Intel 80x86 microprocessors—has grown from a start-up in 1983 to a $250 million company, for a compounded average annual growth rate (CAAGR) of 125%. Profits for the latest fiscal year (ended Dec. 29) came in at $18.8 million.



The strategy is a simple one: Use cheap, standardized chips to build relatively inexpensive but powerful systems that will run many standard software programs. Focused primarily on the on-line transaction-processing (OLTP) market, Sequent touts its systems as low-cost, nonproprietary mainframes. The goal, according to a company source, is "to build a company that would lead a fundamental change in the way computers are built and used."

Sequent recently introduced its latest systems, based on Intel's 80486 chips, which can handle more than 1,000 users at the top end of the product line. The computers range from $23,500 to $2.5 million, and 80% of them are targeted to commercial applications (largely OLTP), despite their roots in technical and design research markets.

Using a multitiered distribution policy, Sequent makes 65% of its sales directly to customers but also maintains OEM agreements with Unisys Corp., Siemens A.G., and MAI Systems.

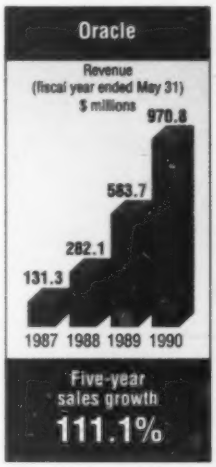
While corporate buyers seeking cheaper alternatives to proprietary mainframes have boosted Sequent's business, the company stands to be hurt by the continued erosion of the mainframe market—namely, the cheaper, more powerful microprocessors that run systems and applications software with mainframe-like performance. Despite its impressive long-term growth, Sequent sources are cautious about the first quarter of 1991 because of the expected slowdown in OEM sales; as a result, the company's earnings and revenue for the quarter ending in March probably will be lower than expected. □

Oracle Corp.
Redwood Shores, Calif.

3

Not too long ago, Oracle Corp.'s cocky CEO Larry Ellison was trumpeting the database company that knew all, saw all, and would overrun all in its software market. For awhile, it seemed that he was right: As of last year, Oracle was running at a CAAGR of 111%.

By late 1990, however, Ellison found that his company had lost some of its magic, and he, himself, had become an object of wrath. Investors, competitors, and customers heaped scorn on the erstwhile high-flyer, which grew to nearly $1 billion last year then took a loss of $36 million in the first quarter of 1990.



Since then, Oracle is delivering on its promises to revamp the once out-of-control management and clamp down on operating costs and overhead that accounted for much of the company's financial headaches. In its second fiscal quarter (ended Nov. 30), the company posted a net profit of $6.7 million on sales of $167 million.

The company is still a major force in the relational database market with its SQL (Structured Query Language) DBMS software and database servers for mainframe, minicomputer, and distributed PC/workstation network environments. But its strategy puts it head-to-head with Digital Equipment Corp. and IBM, as well as pitting it against independents such as Ashton-Tate, which (like Oracle) serves a spectrum of hardware environments. □

Komag Inc.
Milpitas, Calif.

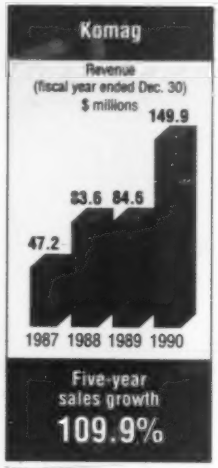
4

Komag president and CEO Stephen Johnson has a term for competitive innovation. He calls it "chasing the rabbit." The "dogs" in the analogy are his company and his competitors; "the rabbit," the goal of providing top-quality, highest-performance disk-media products at a competitive price—while still bringing in respectable profits.

More than 90% of Komag's business is directed at the high-performance disk-drive market. The company makes sputtered thin-film

media instead of oxide media, which is widely used in low-end, older-technology disk drives. Komag competes with Akashic Memories Corp., Nashua Corp., Xidex Corp., and Stolle Corp., among others. The company also supplies OEM drive vendors such as IBM, Seagate Technology, and Hewlett-Packard Co., which also make media but need an outside source to supplement their own production or to make a specific class of drive for which their own media do not qualify.

Cruising along at a CAAGR of 109%, Komag is riding the latest wave in the PC market. Conner Peripherals and other producers provide the disks for low-power 3.5- and 2.5-inch disk drives for notebook-size and laptop computers. The company reported sales of $150 million for its fiscal year 1990 (ended Dec. 31), up 77% from the previous year. Profits that year hit $13.4 million, an abrupt turnaround from the $6.1 million loss during fiscal 1989. The loss stemmed from a drive industry malaise arising from severe price-cutting and glutted inventories, a situation which eventually wiped out a slew of disk and component vendors (including Domain Technology Inc., Komag's biggest U.S. competitor).



In 1987, when the company raised $34 million in its IPO, Komag reported a net income of $8.4 million on sales of $47.2 million.

As of last Dec. 31, Komag had $45 million in cash and $82 million in current assets. The company reports nearly $20 million in long-term debt and $23.9 million in current liabilities.

Komag expects to continue capitalizing on its small-diameter disk business and reportedly is considering buying a thin-film disk-drive head manufacturing operation to expand further into the drive component market. □

Dallas Semiconductor Corp.
Dallas, Tex.

5

When things turned sour for the U.S. semiconductor industry in the mid-1980s, many U.S. vendors found havens in the high-end markets for fast microprocessors, memory chips, and controllers. Those who stayed in the mainstream chip markets found it a tough swim upstream in the wake of Japanese vendors who had beat the standardized memory chip market.

Still, growing a company in such niche havens is tough too, yet Dallas Semiconductor managed it. The company, which posted $100 million in revenue for fiscal 1990 (ended Dec. 30), has capitalized on demand for ASIC chips in a wide gamut of applications. The 1984 start-up has built more than 100 base products that can be customized to specific applications by proprietary technology methods.

Dallas Semiconductor's strategy does confine it to a small field of proprietary solutions vendors—not an entirely sound strategy when the computer industry is stumbling over itself to standardize just about everything in response to customer demand for greater interoperability. Nevertheless, the company grew to $30 million in 1987, the year of its IPO, to $100 million today—a CAAGR of 104%. In its fourth quarter ended Dec. 30, 1990, the company drew net sales of $25.7 million with a $3.6 million profit. For fiscal 1990, the company reported a $13.8 million profit.

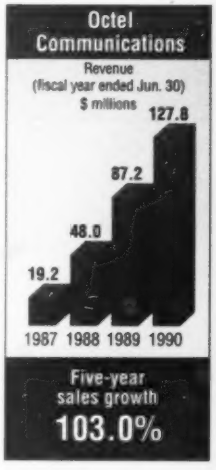
Dallas Semiconductor's products include microprocessor chips that perform teleservicing or equipment-monitoring chips that perform diagnostics and adjustments to vending machines, instruments, and industrial equipment. The company also makes custom DRAMs, SRAMs, microcontrollers, digital signal-processing telecommunications chips, and battery backup devices. Despite what chairman and CEO C. V. Prothro calls "a generally lackluster industry performance last year," the company expects continued growth in application-specific markets. □

Octel Communications Corp.
Milpitas, Calif.

6

Every now and then a new technology comes along that promises huge market potential. Octel Communications chairman and co-founder Robert Cohn may have foreseen that kind of opportunity for voice-processing systems when the company was formed in 1982, but it isn't likely he foresaw Octel's growth to a $130 million company since then—a CAAGR of 103%.

For its fiscal year ended Jun. 30, 1990, Octel posted $128 million in revenue and a $27.2 million net profit. In the first six months of its fiscal 1991, the company reported combined quarterly totals of $72.7 million in revenue and $10.6 million in net profits. Octel went public in February 1988 and has been profitable since the first fiscal quarter of 1987.



Octel's competitors are Rolm, AT&T, Northern Telecom, and VMX in the large corporation/Regional Bell operating company target market. Competition in the contract voice-mail market includes Boston Technology and Digital Sound.

Despite a generally bright outlook, Cohn expects the company to feel the effects of the recession. The reason: Much of their growth comes from sales to contract voice-mail houses, which are prone to pullbacks in tough times. □

continued

Fastest-growing companies

1990 rank	1989 rank	Company	Five-year sales growth* (%)	Fiscal 1990 sales ($ millions)	Fiscal 1990 profits ($ millions)	Fiscal year ended	Industry segment
1	--	**Teradata** Los Angeles	139.8%	$224.2	$18.8	6/90	computers
2	--	**Sequent** Beaverton, Ore.	124.9	248.8	18.8	12/90	computers
3	3	**Oracle** Redwood Shores, Calif.	111.1	970.8	117.4	5/90	software
4	--	**Komag** Milpitas, Calif.	109.9	149.9	13.4	12/90	peripherals
5	--	**Dallas Semiconductor** Dallas	104.4	100.0	13.8	12/90	semiconductors
6	--	**Octel** Milpitas, Calif.	103.0	127.8	17.7	6/90	communications
7	--	**Everex** Fremont, Calif.	87.6	436.5	24.5	7/90	computers
8	4	**Sun Microsystems** Mountain View, Calif.	84.5	2,466.2	111.2	6/90	computers
9	2	**Silicon Graphics** Mountain View, Calif.	81.1	419.8	32.3	6/90	computers
10	38	**Symbol Technologies** Bohemia, N.Y.	75.4	231.5	7.6	12/90	computer-based systems
11	--	**Dell Computer** Austin, Tex.	74.6	546.0	27.2	1/91	computers
12	--	**Convex** Richardson, Tex.	73.0	209.3	18.4	12/90	computers
13	5	**Cadence** San Jose	70.4	231.4	38.0	12/90	software
14	1	**Cypress** San Jose	66.9	225.2	33.2	12/90	semiconductors
15	35	**Seagate** Scotts Valley, Calif.	62.2	2,413.2	117.2	6/90	peripherals
16	--	**Interleaf** Cambridge, Mass.	60.5	88.8	(16.0)	3/90	software
17	--	**BMC Software** Sugar Land, Tex.	58.3	93.0	20.3	3/90	software
18	--	**Borland** Scotts Valley, Calif.	57.8	113.3	11.8	3/90	software
19	--	**FileNet** Costa Mesa, Calif.	56.9	102.9	3.8	12/90	computer-based systems
20	7	**Maxtor** San Jose	56.7	491.1	18.9	3/90	peripherals
21	6	**Novell** Provo, Utah	55.2	497.5	94.3	10/90	software
22	16	**Microsoft** Redmond, Wash.	53.2	1,183.4	279.2	6/90	software
23	13	**Vishay** Malvern, Pa.	51.1	445.6	23.2	12/90	components
24	--	**Informix** Menlo Park, Calif.	50.6	146.1	(23.1)	12/90	software
25	--	**Concurrent** Tinton Falls, N.J.	49.7	340.1	(41.7)	6/90	computers
26	12	**Compaq** Houston	48.2	3,598.8	454.9	12/90	computers
27	8	**3Com** Santa Clara, Calif.	47.7	419.1	20.5	5/90	communications
28	19	**Rexon** Manhattan Beach, Calif.	46.3	158.2	8.5	9/90	peripherals
29	--	**Adaptec** Milpitas, Calif.	43.1	109.3	13.2	3/90	peripherals
30	23	**Computer Associates** Garden City, N.Y.	41.6	1,296.0	157.8	3/90	software
31	15	**Western Digital** Irvine, Calif.	41.4	1,070.5	24.2	6/90	semiconductors
32	10	**Integrated Device** Santa Clara, Calif.	40.4	209.5	17.0	3/90	semiconductors
33	14	**Pyramid Technology** Mountain View, Calif.	39.6	179.7	16.8	9/90	computers
34	21	**EMC** Hopkinton, Mass.	38.7	171.2	8.9	12/90	peripherals
35	29	**Archive** Costa Mesa, Calif.	38.4	293.2	11.5	9/90	peripherals
36	11	**Tandon** Chatsworth, Calif.	38.2	421.8	25.6	12/90	computers
37	17	**Stratus** Marlborough, Mass.	38.2	403.9	37.0	12/90	computers
38	32	**Silicon Valley Group** San Jose	38.0	184.3	4.4	9/90	semiconductor equipment
39	24	**LSI Logic** Milpitas, Calif.	36.2	655.5	(34.0)	12/90	semiconductors
40	--	**Applied Biosystems** Foster City, Calif.	34.9	158.9	6.1	6/90	medical equipment
41	27	**Micron Technology** Boise, Idaho	34.4	333.3	4.9	8/90	semiconductors
42	26	**QMS** Mobile, Ala.	33.0	276.3	14.6	9/90	peripherals
43	34	**VLSI Technology** San Jose	32.8	324.8	(12.7)	12/90	semiconductors
44	28	**Micropolis** Chatsworth, Calif.	32.0	380.6	7.9	12/90	peripherals
45	47	**Anthem Electronics** San Jose	31.4	408.2	23.2	12/90	distribution
46	30	**Intermec** Lynnwood, Wash.	31.2	168.5	11.5	3/90	computer-based systems
47	20	**AST Research** Irvine, Calif.	31.0	533.8	35.1	6/90	computers
48	51	**Data Switch** Shelton, Conn.	30.1	121.8	3.3	12/90	components
49	48	**Quantum** Milpitas, Calif.	30.0	446.3	47.2	3/90	peripherals
50	18	**Flextronics** Fremont, Calif.	27.5	171.3	(36.7)	3/90	contract manufacturer

*Compounded average annual growth rate

(continued)

Fastest-growing companies

1990 rank	1989 rank	Company	Five-year sales growth* (%)	Fiscal 1990 sales ($ millions)	Fiscal 1990 profits ($ millions)	Fiscal year ended	Industry segment
51	52	**Applied Materials** Santa Clara, Calif.	26.6%	$567.1	$34.1	10/90	semconductor equipment
52	31	**Mentor Graphics** Beaverton, Ore.	26.1	435.2	23.6	12/90	software
53	50	**Inmac** Santa Clara, Calif.	25.3	288.4	3.6	7/90	communications
54	--	**Solectron** San Jose	25.0	204.7	7.4	8/90	contract manufacturer
55	74	**Applied Magnetics** Goleta, Calif.	25.0	368.3	(10.0)	9/90	peripherals
56	43	**Lotus** Cambridge, Mass.	24.9	684.5	23.3	12/90	software
57	91	**DSC Communications** Plano, Tex.	24.3	519.3	20.3	12/90	communications
58	49	**Tandem** Cupertino, Calif.	24.0	1,865.9	121.8	9/90	computers
59	--	**Atari** Sunnyvale, Calif.	23.7	411.5	(20.8)	12/90	consumer electronics
60	44	**Apple** Cupertino, Calif.	23.7	5,558.4	474.9	9/90	computers
61	40	**Richardson Electronics** La Fox, Ill.	23.6	160.1	1.0	5/90	components
62	89	**Intel** Santa Clara, Calif.	23.5	3,921.3	650.3	12/90	semiconductors
63	39	**Stanford Telecom** Santa Clara, Calif.	22.5	89.4	(0.7)	3/90	government
64	41	**BancTec** Dallas	22.0	185.8	10.5	3/90	computer-based systems
65	36	**KLA Instruments** Santa Clara, Calif.	21.7	167.9	9.4	6/90	instruments
66	63	**Xicor** Milpitas, Calif.	21.5	91.2	(18.0)	12/90	semiconductors
67	54	**ASK Computer** Mountain View, Calif.	21.2	207.5	5.0	6/90	software
68	46	**Microsemi** Santa Ana, Calif.	20.8	88.9	(11.5)	9/90	semiconductors
69	65	**Westmark International** Seattle	20.6	484.9	18.7	12/90	medical equipment
70	55	**Loral** New York	20.5	1,274.3	77.5	3/90	government
71	33	**Emerson Radio** N. Bergen, N.J.	20.2	891.4	10.4	3/90	consumer electronics
72	60	**Amdahl** Sunnyvale, Calif.	20.2	2,158.8	184.0	12/90	computers
73	--	**Diasonics** Milpitas, Calif.	19.0	267.1	16.4	12/90	medical equipment
74	67	**Molex** Lisle, Ill.	18.6	594.4	62.1	6/90	components
75	53	**Hutchinson** Hutchinson, Minn.	18.4	122.4	5.3	9/90	components
76	--	**Sensormatic** Deerfield Beach, Fla.	18.3	191.3	20.0	5/90	computer-based systems
77	--	**MAI Systems** Tustin, Calif.	18.2	389.5	(64.5)	9/90	computers
78	88	**Medtronic** Minneapolis	18.1	836.6	108.7	4/90	medical equipment
79	--	**Exide Electronics** Raleigh, N.C.	18.1	172.4	5.0	9/90	components
80	--	**Dionex** Sunnyvale, Calif.	18.1	80.6	13.0	6/90	instruments
81	37	**Telxon** Akron	17.5	143.4	(14.4)	3/90	computer-based systems
82	68	**SCI Systems** Huntsville, Ala.	17.0	1,179.0	2.3	6/90	government
83	--	**LAM Research** Fremont, Calif.	16.9	137.3	(8.8)	6/90	semiconductor equipment
84	92	**Pacific Scientific** Newport Beach, Calif.	16.4	183.9	1.5	12/90	instruments
85	87	**Keithley Instruments** Cleveland	16.4	100.6	3.4	9/90	instruments
86	--	**Norstan** Maple Grove, Minn.	16.3	115.6	(0.8)	4/90	communications
87	45	**Cray Research** Minneapolis	16.2	804.4	113.0	12/90	computers
88	94	**Tellabs** Lisle, Ill.	16.1	211.0	8.1	12/90	communications
89	69	**ADC Telecom** Bloomington, Minn.	15.8	259.8	22.9	10/90	communications
90	61	**Valid Logic Systems** San Jose	15.6	158.5	(44.1)	12/90	software
91	72	**Marshall Industries** El Monte, Calif.	15.4	543.7	20.1	5/90	distribution
92	86	**Hewlett-Packard** Palo Alto, Calif.	15.3	13,233.0	739.0	10/90	instruments, computers
93	95	**Genicom** Waynesboro, Va.	15.1	255.3	1.1	12/90	peripherals
94	--	**National Computer** Minneapolis	15.1	315.3	13.0	1/91	software
95	78	**Unisys** Blue Bell, Pa.	15.0	10,111.3	(436.7)	12/90	computers
96	--	**Motorola** Schaumburg, Ill.	14.8	10,885.0	499.0	12/90	semi, communications
97	56	**Ultimate** East Hanover, N.J.	14.8	209.7	0.1	4/90	software
98	--	**Titan** San Diego	14.7	124.0	2.2	12/90	government
99	77	**Intergraph** Huntsville, Ala.	14.7	1,044.6	62.6	12/90	computers
100	85	**Evans & Sutherland** Salt Lake City	14.6	157.6	16.6	12/90	computers

*Compounded average annual growth rate

Source: Electronic Business *(continued)*

Facts behind the figures

Rules of the game

Like any competition, the ELECTRONIC BUSINESS fastest-growing company ranking has rules. That means a company you might have expected to see on the list did not make it. For example, Conner Peripherals, Chips and Technologies, and several other companies listed on the right did not make our list because they did not have sales in our base year, 1985. SynOptics had sales recorded in 1985 but not for the entire year. Network Equipment Technologies, Cirrus Logic, and Encore Computer did not qualify since their 1985 sales were under $1 million. Other rules: The company must be U.S.-based and publicly held; 50% or more of its total revenue must be from electronics sales; and sales for fiscal 1990 must be $80 million or more. □

Who didn't make the list

Company	1990 sales ($ millions)	Why they didn't make it
Chips and Technologies	$ 293.4	First full year of sales in 1986
Conner Peripherals	1,337.6	No sales until 1987
Exabyte	170.3	No sales until 1987
Executone Information Systems	280.5	Company formed in July 1988
Mips Computer Systems	152.3	No sales until 1986
Network Equipment Technologies	180.8	Base year (1985) less than $1 million in sales
Cirrus Logic	85.0	Base year (1985) less than $1 million in sales
Encore Computer	215.2	Base year (1985) less than $1 million in sales
SynOptics Communications	176.0	First full year of sales in 1986

New arrivals to the fast track . . .

Company	Five-year sales growth*	1990 sales ($ millions)	1990 rank
Teradata	139.8%	$224.2	1
Sequent Computer	124.9%	248.8	2
Komag	109.9%	149.9	4
Dallas Semiconductor	104.4%	100.0	5
Octel Communications	103.0%	127.8	6
Everex Systems	87.6%	436.5	7
Dell Computer	74.6%	546.0	11
Convex Computer	73.0%	209.3	12
Interleaf	60.5%	88.8	16
BMC Software	58.3%	93.0	17

. . . and those that have departed

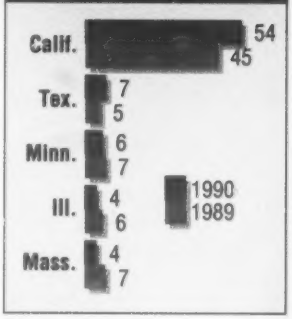
			1989 rank
Wyse Technology	NA	NA	22
Ashton-Tate	13.7%	230.5	25
Digital Communications	13.5%	203.2	42
Computer Task Group	NA	NA	57
Western Micro Technology	12.8%	84.3	58
Bolt Beranek and Newman	13.4%	261.9	59
Dynascan	10.2%	169.0	62
Dynatech	12.6%	433.3	64
Digital Equipment	14.1%	12,942.5	66
Daisy Systems	NA	NA	70

NA=Information not available due to acquisitions or change in operating status
* Compounded average annual growth rate

Hearty hellos

Welcome to 27 new companies who made the 10 fastest-growing company list this year. Most of the companies who are newcomers are being added to the 1991 list as they reach the prerequisite age of six years old. The number-one and number-two fastest growers, Teradata and Sequent Computer, made it with over $200 million in annual sales in fiscal 1990. Motorola made it back—just barely—in position number 96. Of course, 27 newcomers means 27 companies that are gone from last year's list. Three departing companies that ranked highest last year but didn't return this year (through failure to perform or acquisition) include Wyse Technology, Ashton-Tate Corp., and Digital Communications Associates. The remaining companies that didn't return were in the bottom 50 of the ranking in 1989. □

Where they are located



Here I come!

California's high-tech soil was rich and fertile again in 1990. Fifty-four of the fastest-growing companies are located there, with nearly half of those from Silicon Valley alone. (In 1989, California claimed 45 of the 100 fastest-growing companies.) Texas contributed 7, and Minnesota had 6 this year. Meanwhile, hard-hit Massachusetts and New York saw the number of fast-growing companies decline drastically. □

How the fastest continue performing

Fastest-growing electronics companies through the years

Year ranked	Fastest-growing company	Where they are today
1990	**Teradata**	Ranked #1 with 139.8% growth on sales of $224.2 million
1989	**Cypress**	Ranked #14 with 66.9% compound growth rate on sales of $225.2 million
1988-87	**Sun Microsystems**	Ranked #8 this year with 84.5% growth and #4 last year with 114.5% growth
1986	**MiniScribe**	Acquired by Maxtor (ranked #20) last summer
1985	**Convergent Technologies**	Acquired by Unisys (ranked #95) in September of 1988
1984	**TeleVideo**	Fiscal year sales fell to $45.6 million

Where are they now?

The 1989 winner, Cypress Semiconductor, has dropped to a still respectable number 14 on this year's fastest-growing list. The two-time winner (in 1987 and 1988) Sun Microsystems continues to shine, placing 8th this year and 4th last year. Two former fast-growing winners, MiniScribe and Convergent Technologies, were acquired. MiniScribe, the troubled disk-drive maker, sold most of its assets to Maxtor, a maker of data-storage products, last summer. Computer systems maker Convergent Technologies was acquired by Unisys in the fall of 1988. Meanwhile, revenue for 1984 winner TeleVideo actually fell in the latest fiscal year to $45.6 million. The microcomputer maker's sales peaked at $173 million in fiscal 1983 and have been steadily declining ever since. □

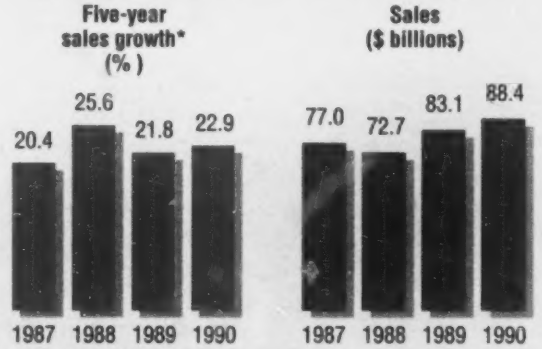
Hurrah for 1990

All 100 of the fastest-growing companies averaged 22.9% five-year sales growth in the 1990 ranking, up one point from the year before. (Five-year sales-growth figures were calculated at a compounded average annual rate from fiscal 1985 to 1990.) This year's fastest growers had the second-best five-year growth rate since ELECTRONIC BUSINESS began compiling the ranking in 1985. On average, each company in the top 100 sold $88.4 billion worth of products and services in 1990, up over $5 billion from the previous year. In 1986 the 100 fastest growers averaged 13.6% five-year sales growth, but their fiscal 1986 sales hit $129.2 billion.

Over one-fifth of the fastest-growing companies are computer makers. With combined sales of $32 billion, they represent over one-third of total sales. The next two largest groups are peripheral and software makers. □

The overall picture

Figures for the fastest-growing electronics companies



* compounded average annual growth rate

Big, and getting bigger fast

Perhaps the most amazing companies in the ELECTRONIC BUSINESS 100 fastest-growing list are those that are big and still manage to grow rapidly. This year, 16 fast-growth companies had over $1 billion in sales in fiscal 1990. This outstanding group grew sales nearly 21% on average over the past five years and accounted for 72% of all the 100 fastest-growers' sales.

Although the largest electronics and computer company—IBM, with 1990 sales of $69 billion—wasn't on the list, other top ten companies still fast-growing including Hewlett-Packard and Motorola. □

The billion-dollar club

Company	Five-year sales growth*	1990 sales ($ millions)	1990 rank
Sun Microsystems	84.5%	$2,466.2	8
Seagate Technology	62.2%	2,413.2	15
Microsoft	53.2%	1,183.4	22
Compaq Computer	48.2%	3,598.8	26
Computer Associates	41.6%	1,296.0	30
Western Digital	41.4%	1,070.5	31
Tandem Computers	24.0%	1,865.9	58
Apple Computer	23.7%	5,558.4	60
Intel	23.5%	3,921.3	62
Loral	20.5%	1,274.3	70
Amdahl	20.2%	2,158.8	72
SCI Systems	17.0%	1,179.0	82
Hewlett-Packard	15.3%	13,233.0	92
Unisys	15.0%	10,111.3	95
Motorola	14.8%	10,885.0	96
Intergraph	14.7%	1,044.6	99

* Compounded average annual growth rate

Peripherals outrace fast-growth markets

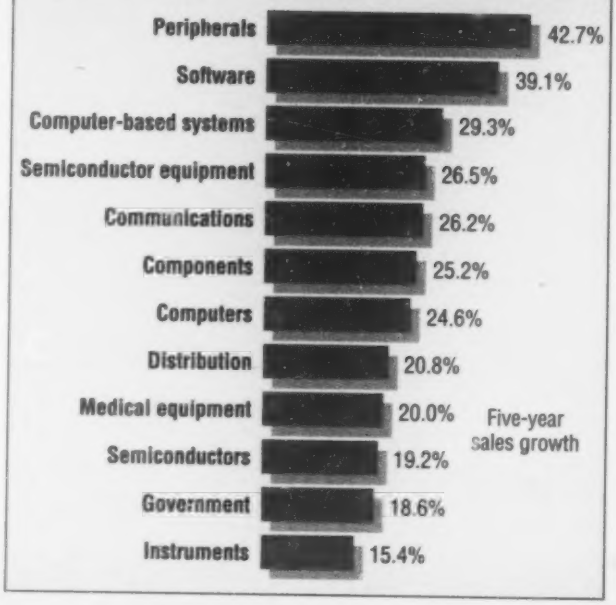
Fast growth by 12 manufacturers of computer peripheral equipment pushed the peripherals market segment growth above the software group, reversing last year's trend. With Komag at number 4 and Seagate Technology at 15, the peripherals market continues to be a hot spot in the electronics industry. Software makers, including 15 companies in the fastest-growing list, saw their five-year compounded growth rate slow from 46% in 1988, to 44% in 1989, and to 39% in 1990. Still, not a bad showing this year thanks to fast-growth companies such as this year's third-place company, Oracle Systems.

Despite the fact that the two fastest-growing companies in 1990, Teradata and Sequent Computer, are both computer companies, the computer market segment saw a five-year average growth rate of just 25%.

The semiconductor market, which had seen 29% long-run growth in 1988 and 23% growth in 1989, slowed to just 19% five-year average growth this year. With 11 companies in this segment, Dallas Semiconductor boosted the group's overall growth; but Motorola, with $10.9 billion in sales in 1990, brought down the group's weighted average gain.

Communications added six companies to the fastest-growing list and saw an average 26% five-year growth. Octel contributed to the group's success. □

The fastest-growing segments



An in-depth look at the fastest-growing industry segments

	Five-year sales growth**	1990 rank
Communications (6)*		
Octel Communications	103.0	6
3Com	47.7	27
DSC Communications	24.3	57
Weighted average	**26.2**	
Components (6)*		
Vishay Intertechnology	51.1	23
Data Switch	30.1	48
Richardson Electronics	23.6	61
Weighted average	**25.2**	
Peripherals (12)*		
Komag	109.9	4
Seagate Technology	62.2	15
Maxtor	56.7	20
Weighted average	**42.7**	
Computers (21)*		
Teradata	139.8	1
Sequent Computer	124.9	2
Everex	87.6	7
Weighted average	**24.6**	
Computer-based systems (6)*		
Symbol Technologies	75.4	10
FileNet	56.9	19
Intermec	31.2	46
Weighted average	**29.3**	
Semiconductors (11)*		
Dallas Semiconductor	104.4	5
Cypress Semiconductor	66.9	14
Western Digital	41.4	31
Weighted average	**19.2**	
Distribution (2)*		
Anthem Electronics	31.4	45
Marshall Industries	15.4	91
Weighted average	**20.8**	
Government (4)*		
Stanford Telecom	22.5	63
Loral	20.5	70
SCI Systems	17.0	82
Weighted average	**18.6**	
Semiconductor equipment (3)*		
Silicon Valley Group	38.0	38
Applied Materials	26.6	51
LAM Research	16.9	83
Weighted average	**26.5**	
Instruments (5)*		
KLA Instruments	21.7	65
Dionex	18.1	80
Keithley Instruments	16.4	85
Weighted average	**15.4**	
Medical equipment (4)*		
Applied Biosystems	34.9	40
Westmark International	20.6	69
Diasonics	19.0	73
Weighted average	**20.0**	
Software (15)*		
Oracle Systems	111.1	3
Cadence Design Systems	70.4	13
Interleaf	60.5	16
Weighted average	**39.1**	

*Number of companies included in segment

**Compounded average annual growth rate

Japanese makers take aim at fast-growing static-RAM market

High-volume makers dominate the market's low end. Now they are eyeing the high end. U.S. makers could suffer severe price erosion

BY DAVE WEBB

As the market for higher-performance personal computers heats up, the demand is rising rapidly for very fast static-RAMs (SRAMs) used as cache memories. That could be good news for Japanese SRAM makers and bad news for domestic vendors. Indeed, several domestic SRAM makers have already called it quits, notably National Semiconductor, Advanced Micro Devices, Philips Components, Saratoga Semiconductor, and VLSI Technology.

The Japanese already dominate the slower segments of the SRAM market. Now they are starting to target the faster end of the market for chips with speeds of 20-nanoseconds and under. Competition from the high-volume, cost-efficient Japanese manufacturers may force the domestic vendors into smaller and less profitable niche application markets. The days of cozy competition and juicy profits are over.

"The Japanese are definitely moving into the very fast end of the market," says SRAM market analyst Walt Lahti at In-Stat Inc. in Scottsdale, Ariz. "U.S. companies are still very strong, but I think that market segment is getting big enough to attract the really big players."

According to the market research firm Integrated Circuit Engineering Corp. (ICE) in Scottsdale, Fujitsu leads the pack with an 11% market share, closely followed by Toshiba, Hitachi, NEC, and Mitsubishi. The Japanese garnered 40% of the $2.9 billion worldwide MOS SRAM market in 1990, ICE estimates.

Any aggressive SRAM pricing moves by the Japanese companies would be particularly welcomed by developers of 80386- and 80486-based personal computers. Price/performance is a critical competitive issue in the PC marketplace where cheaper fast SRAMs will help keep system prices down. The same is true for vendors using Motorola's 86030 and 86040 chips and for the vendors of RISC systems, such as those based on Sun Microsystems' Sparc architecture. For them, cheap cache SRAMs make it easier to cut costs.

Cache memories essentially allow data from the relatively slow input/output channels to be made rapidly available to the microprocessor. The cache has to be fast to maintain a "zero-wait-state"—that is, without any hesitation in system performance resulting from an input/output bottleneck between the system processor and its disk-drive storage.

Some Japanese manufacturers make no secret of their aims in fast SRAMs. Ken Pope, Hitachi America's memories and mass storage strategic program manager, says Hitachi has "always been a player in the fast SRAM market," but now the company sees more opportunity in high-end PC and workstation cache memory markets.

Ken Pope, strategic program manager for Hitachi's Memories and Mass Storage Division

"We have seen a lot more caches in high-end PCs in recent months, and while we ship across the spectrum [of static-memory chips], that is a market you can be sure we will focus on," Pope says. Hitachi is aggressively marketing fast 1-Megabit SRAMs and is pioneering the yet-to-emerge fast 4-Mb market.

"Until two years ago fast SRAMs were a niche," says Integrated Device Technology Inc.'s vice president of marketing Larry Jordan. "Now, any system that has been designed in the last two years with [a clock speed of] 25 Megahertz uses a fast SRAM for cache, and as that performance demand curve rises, so will demand for SRAM speed and density."

Jordan agrees that offshore vendors will have to be contended with in the high end very soon. "As it grows past the $1 billion mark here, there are some well-defined parts—the Intel system standard cache market, as an example—that the Japanese will dominate by virtue of their manufacturing power," Jordan says.

Other markets for fast SRAMs beyond PC cache memories are main memory applications in portable computers and computer-control applications. Hitachi expects to target these markets too, says Pope.

The worldwide market for NMOS, CMOS, and BiCMOS SRAMs is expected to reach $2.9 billion this year, according to ICE, who predicts that the market will grow to $4 billion next year, $4.5 billion in 1993, $5.1 billion in 1994, and $5.6 billion in

1995. Japanese vendors now control 43% of the market, with U.S. and Canadian vendors taking up 35%. ICE estimates that Europe and the rest of the world account for the other 25% of the market.

Dataquest projects the worldwide market for very fast SRAMs (less than 20 nanoseconds access time) will grow 17.5% this year. In 1990 the market was $312 million; this year the market is expected to grow to $378 million. Dataquest estimates revenue will climb to $537 million in 1992, $772 million in 1993, and $855 million in 1994.

SRAM market on the rise

total worldwide revenue, MOS SRAMs ($ billions)

Source: Integrated Circuit Engineering Corp.

In the second half of last year the SRAM market was in a volatile state. Too many vendors were shipping products into a softening market, creating price erosion that caused several U.S. vendors to abandon the market. Pricing has since stabilized, but if demand slacks off again more vendors may decide to quit.

"There are still more than 40 players in this market," says In-Stat's Lahti. "That is a lot for a market that is near $2.5 billion—more than the market can comfortably support."

"I agree with that," says Motorola's fast SRAM marketing manager Curt Wyman. "But if you look at the major players, I wouldn't imagine you would see much change. The little guys always come and go. The perspective to consider is that this was once a high-margin business; now you don't have the margins that attracted people to the market."

In-Stat reports that out of the 36 vendors in the under-35-nanosecond marketplace, Cypress and IDT are the worldwide market leaders, with Toshiba now the top player from Japan in that segment, Hitachi coming on strong, closely followed by Korea's Samsung Semiconductor.

"Something is going to have to happen to make room for these big guys," In-Stat's Lahti says, adding that fast SRAM players without manufacturing clout may have to follow Motorola's example and target application-specific SRAM markets.

Ione Ishii, a Dataquest semiconductor industry analyst, says Motorola has been exceptionally successful since its SRAM business essentially came out of nowhere in the last year and a half. "They are really growing fast in that market," Ishii said. "They grew 35% in 1989, and they were the only U.S. company with double-digit revenue growth in that market last year."

According to Motorola's Wyman, the company's success is a by-product of its core microprocessor business. The company aggressively positioned its cache SRAM business in line with its other microprocessor and memory chip products to market to its large-system customers.

The company has managed to make enormous strides in growing its application-specific SRAM sales as well, an area which made up 20% of its 1990 sales revenue. "The number of dollars generated by SRAM sales has grown significantly for us in the last year," Wyman reports. "And application-specific statics helped out tremendously."

IDT's strategy is to remain a supplier at the top end of the market. "There is nothing in the formula for success that says the Japanese will change. They will always avoid building specialized parts. The fast SRAM market is growing large enough to attract them, but when the market gets to $1 billion, we will be addressing the $150 million segment at the top end."

With the expected increases in personal computer system performance, just about every system being shipped several years from now will have SRAM cache memory chips, Jordan and others say. The key for U.S. vendors will be to stay ahead of the performance and density curves just as Motorola and IDT say they are doing. □

A Static-RAM Primer

Static-RAM chips vary greatly in performance, density, and process design. Typically, SRAM access speeds range from 120 nanoseconds to as fast as 10 nanoseconds. The slow market is composed of vendors marketing 70-nanosecond and slower chips. The fast market is made up of makers selling 25-nanosecond to 70-nanosecond access chips. The very fast encompasses those chips faster than 25 nanoseconds.

Densities, another word for the data capacity of an SRAM chip, range from 4 kilobits to 16K at the obsolete end of the market to 4 Mb at the top. The biggest markets at the moment are the 64K and 256K segments. Some vendors are shipping 1-Mb chips, but that is an emerging segment.

SRAM silicon processes include the MOS family of NMOS, CMOS, and the bipolar/CMOS hybrid, BiCMOS. Bipolar family processes include TTL, which is quickly becoming obsolete, and ECL. The ECL architectures are the fastest static-RAM chips available and are used in mainframe and supercomputing applications.

Chips are also sold according to their architectural design. Designations such as "8K x 8" refer to the number of rows of bits and their arrangement on the chip. An 8K x 8 chip has 8 rows of 8 bits each, which would mean it is a 64K chip.

SRAMs, as a result, range from 1-Mb 35-nanosecond 256K x 4 BiCMOS chips to 4K 8-nanosecond 4K x 1 CMOS SRAMs, with a gamut of combinations in between. □

Desktop scanning moves into the office

Putting documents and images into desktop computers is a growth business. But can output technology keep up?

BY JOHN PARKER

The ability to put images into a computer gave the scanner market its first push. Transferred to documents, the technology became a boon to office efficiency. Now, the ability to scan both words *and* pictures is creating a whole new market in computer applications—and some impressive sales growth as well.

In the desktop-publishing industry, where it all began, scanner sales should grow from $156 million in 1989 to $290 million in 1993, according to market researcher BIS Strategic Decisions in Norwell, Mass. Market Intelligence Research Group Co. in Mountain View, Calif., puts combined optical character recognition (OCR) and image-scanner sales at $520 million in 1994, compared with $264 million in 1987.

OCR and image scanning begin life in the same fairly conventional optical technology. The key hardware components are charge-coupled devices (CCDs), a combination of a light source, mirrors, and a row of photodiodes that sense the light reflected from the scanned object. The result is a matrix, or "bit map," of the image or document. Users can edit the resulting document file or alter the resulting image file on their PC or Mac.

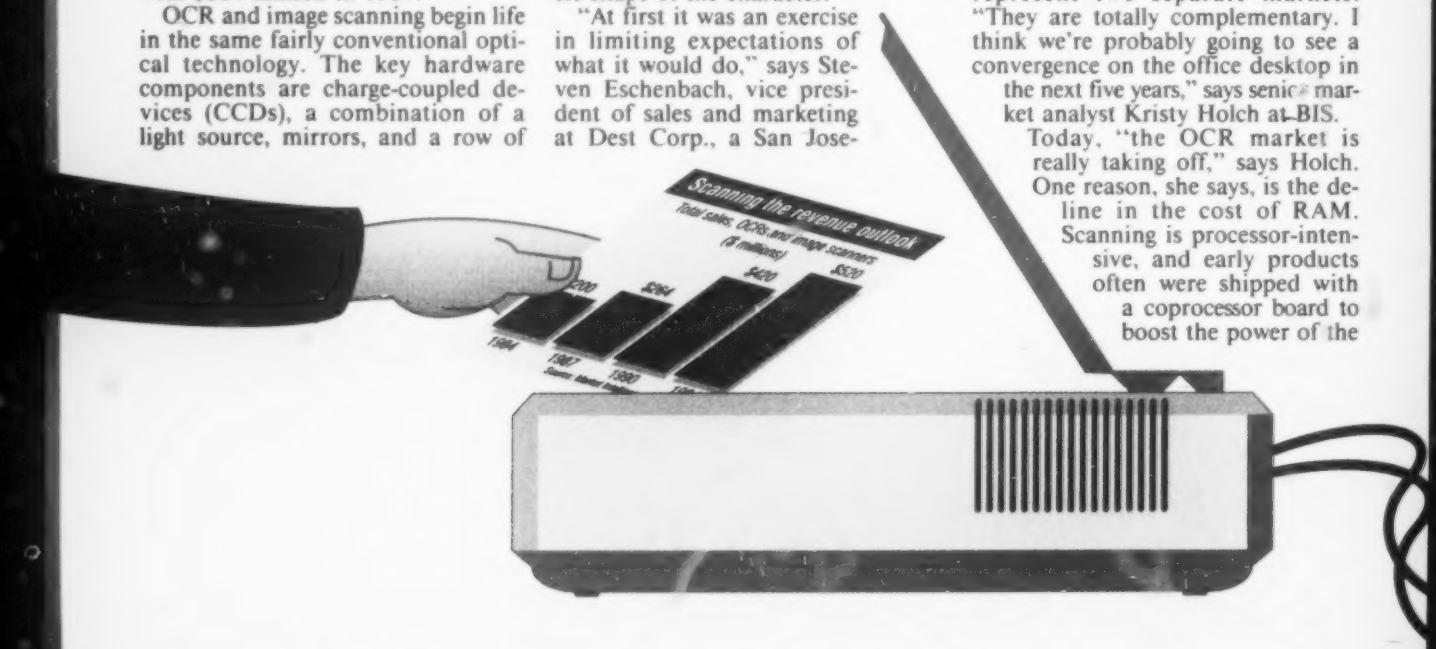
Scanner hardware, or "engines," are fairly standard. What differentiates scanner products is software: In order for the computer to analyze the bit map, formulas and algorithms are needed. OCR is primarily a software product, and for OCR vendors the main costs essentially are software development. Early OCR packages could recognize only a single font; today's omni-font OCR packages read the document by recognizing the basic shape of the character.

"At first it was an exercise in limiting expectations of what it would do," says Steven Eschenbach, vice president of sales and marketing at Dest Corp., a San Jose-based manufacturer of OCR hardware and software. Dest introduced OCR for desktop document use in the 1970s, but its first product couldn't read typeset copy, such as magazines and newspapers. In 1986, Dest introduced a $3,000 desktop unit that read about a dozen type styles. The scanner contained a microprocessor because matrix-matching took too much power for the desktops of the day.

Eschenbach calls 1986—the year that saw the coining of the phrase "desktop publishing"—the pivotal year for desktop scanning. "Suddenly, people wanted pictures in their computers," he says, and "all the little bits of the technology came together."

OCR and image scanners no longer represent two separate markets. "They are totally complementary. I think we're probably going to see a convergence on the office desktop in the next five years," says senior market analyst Kristy Holch at BIS.

Today, "the OCR market is really taking off," says Holch. One reason, she says, is the decline in the cost of RAM. Scanning is processor-intensive, and early products often were shipped with a coprocessor board to boost the power of the



desktop computers on which scanning software was supposed to run.

The office, not desktop publishing, represents the growing market, even though it was publishing that got scanning started, says Holch. "Getting a document into your office computer has become very desirable. We're seeing scanner sales tied to software sales, as well as the other way around."

It's not hard to understand the appeal of document scanning in the modern office, given that word-processing is still the major office desktop software application. The American Bar Association calculates it takes 15 uninterrupted minutes to retype a page from a legal document into a word processor, while it takes just 6 minutes to scan the same document into the office computer.

Teaming up

Office applications should multiply as scanning moves into the central processing unit of the desktop computer. An example may be facsimile transfer. Experts say software soon may convert faxes to finished documents and route those documents to your computer. Page-layout packages will have a scanning option on menu. A scanner may digest a magazine page, pictures and text, with one scan and dump it onto the network. "We're growing toward a lot more integration," says Holch. "For software and hardware makers, it will be important to make strategic alliances with OEMs."

Such partnerships are important to Calera Recognition Systems Inc. of Santa Clara, Calif., an OCR-dedicated company whose products range from $600 scanning software to a $30,000 high-speed scanner for which Calera makes software and hardware. A recent agreement with Kodak calls for use of Calera software in a scanner that reads forms at high speed—an application in big demand among insurance companies, for example. "We're looking at a number of those partnerships," says Barney Dewey, Calera's vice president of product development.

One future partnership, says Dewey, might involve a digital copier. Such a machine, he says, might have a "copy" button and a "read" button. The "read" command could scan and store images and documents for future use. "OCR is getting integrated into other applications," says Dewey, citing the integration of Calera's WordScan into Microsoft's Word for Windows.

The Windows environment itself will have a powerful effect on the scanner market, says Dewey, by extending the graphical capabilities of MS-DOS users. In the graphics-oriented world of the Macintosh computer, per-capita use of scanners is higher than it is among users of DOS-based PCs. Predicts Dewey, "Windows will change that."

The change has begun. When Micrografx Inc., a high-flying Richardson, Tex.-based developer of Windows applications, went shopping for its first acquisition late last year, it went all the way to Londonderry, N.H., offering $5.1 million for Astral Development Corp. The deal gives Micrografx, with $17.8 million in sales, a product that will let users edit images in Windows. For Astral, the deal means product-development money and a retail distribution channel for its Picture Publisher image-editing software. The acquisition was completed early last month, with Micrografx issuing 250,000 shares of its own stock in exchange for the stock of Astral.

Further evidence of the merging of scanning technologies can be found in Cambridge, Mass., where Xerox Imaging Systems Inc. recently moved its headquarters from Sunnyvale, Calif. XIS is a combination of three efforts: parent company Xerox Corp.'s emphasis on office systems, Kurzweil Computer Products' omnifont document scanner technology, and Datacopy's imaging expertise and established distribution channel.

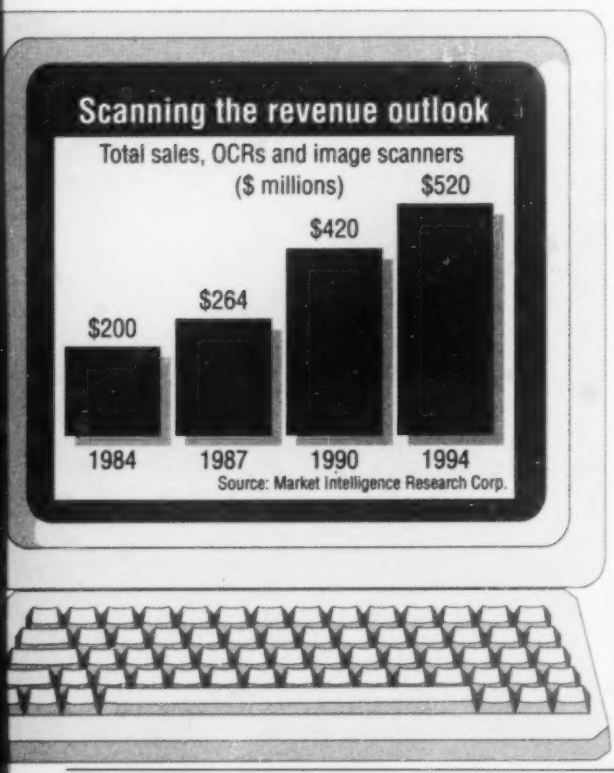
According to Wayne Crandall, vice president for sales and corporate marketing at XIS, the company's strategy is based on four product lines: one for the PC, one for the desktop, and one for the Sun workstation environment, in addition to the Kurzweil Personal Reader line of scanning products for the visually impaired (the products that got Kurzweil started in Cambridge in 1975).

Shifting price points

Increased demand, falling memory cost, improved software, and heightened competition combine to cut prices. When the desktop-scanner market got rolling in the late 1980s, packages cost $500 to $1,000 for the software alone. A four-bit scanner with 16-level gray scale went for $2,500. Now, says Holch, "you could buy a color scanner with that much money. Pentax offers a 16-level gray scale scanner for just under $1,000. The pricing decline will continue, though not as dramatically."

At the high end are $10,000-$20,000 high-speed scanners that appeal to document-intensive businesses such as banks, libraries, law firms, or drug companies. But the strongest dollar-sales growth is expected in the midrange market and represented by an office where a scanner sits next to the network printer. Such a scanner might fetch a street price of $1,200.

At the low end, the pace of unit



shipments could create growth rivaling that of the midrange market, Holch says. Individual users might pay a $600 street price for a scanner that has no gray scale but that has a detachable scanning bar that lets it double as a page-feed or hand-held device. Users would pay another $200 to $300 for software.

"Meanwhile, you cannot overlook hand-held scanners selling at $200 to $700," according to Holch. "We thought they'd peter out, but they've enhanced their capabilities to the point where they are a great entry point for users. In fact, they support the whole scanner market by doing that."

Xerox Imaging Systems divides its scanner technology across several product lines, says VP Wayne Crandall, including PCs and products for the visually impaired

Reigning champion of the midrange desktop-scanner market is Hewlett-Packard Co. Market analysts estimate HP's ScanJet product line holds a two-to-one advantage over its closest competitor. The Palo Alto-based company's strength in output technology with its LaserJet printers helped HP develop its scanner products for office use.

And HP apparently intends to keep its focus on the midrange. "There are definite limits on sheet-feed and hand-held design," says Gary Kaiser, marketing section manager for HP's Greeley (Colo.) Hardcopy Division. "We've done quite a bit to understand user needs. We're focused on people doing real work where they need something robust."

Selling to the scanner market

Major trends for OCR and scanner distribution:

- **Direct sales become less important as the role of high-end products diminishes;**
- **Manufacturer-distributor partnerships become more important with growth of midrange and low-end;**
- **Dealer distribution deals will continue as cheaper, simpler scanners become available;**
- **VARs and integrators will cash in because of their expertise in vertical markets.** □

Source: Market Intelligence Research Corp.

Input vs. output

The limits to scanner growth seem to have less to do with the technology of putting information into the desktop computer than with output. That's certainly the case with color scanning. Some say it will be 10 years before color scanners compete one-to-one with monochrome scanners. Others say it will never happen.

"The availability of a color scanner doesn't mean you have the solution," says HP's Kaiser. "It can even create more problems. Color is in our plans, but we want to deliver a really usable product."

Part of the problem is the huge bit load colored images create, says Holch. Another problem is the lag in developing color monitors. And a third is the lack of effective color printers. Your company might spend six months scanning images into the desktop and designing a new logo, for example, only to find the shade of blue you wanted can't be reproduced on paper.

Then there's the standards problem. "We need a standard interface for scanners," says Holch, "so that people writing scanning software don't have to write a separate driver for each scanner on the market. Right now, most scanners are compatible with TIFF [Tagged-Image File Format], so if worse came to worst, you could convert an image file just as you convert a document file to ASCII. But that's a lot to bother with."

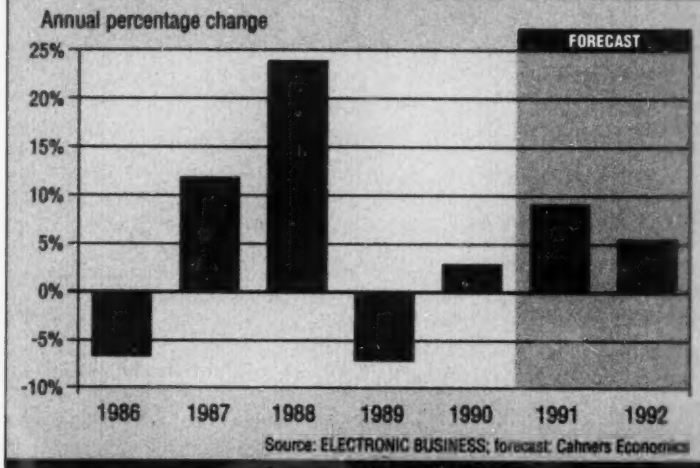
Astral Development made its name by tackling another key problem: All images are not created equal. They come from different sources, and they are output on different printers.

"No two CCDs are alike," says Astral president Frank Mazza. For example, the halogen lamps that are the scanner engine's light source can dim over time, and that affects the image that is transferred to the computer. Some of Astral's software is able to calibrate bit-mapping to compensate for flaws in the scanner. Other Astral software calibrates the dot-gain of a specific type of printer to match the scanner.

For OCR companies, the challenge of the next five years will be to move away from stand-alone software packages and make their products application-oriented, says XIS's Crandall. If companies meet this challenge, he says, users will be able to scan documents by manipulating an icon on their computer screen.

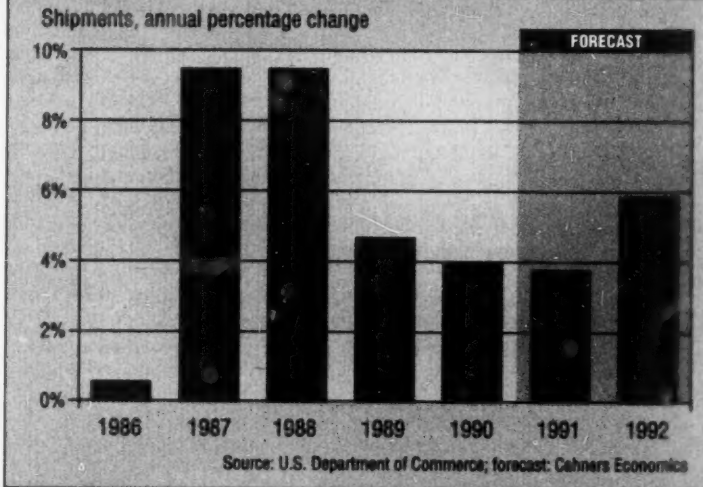
Calera's Dewey has his own vision of the future. "There are indications the scanner market will bifurcate," he says. "High-end scanner sales growth will go up, and at the same time there might be a market for a low-end scanner that does much of the job now done by a computer keyboard." □

ATE revenue will continue to revive in 1991...



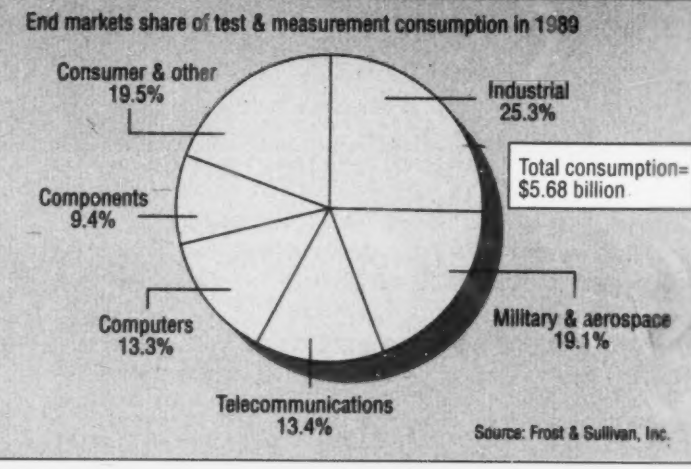
Source: ELECTRONIC BUSINESS; forecast: Cahners Economics

...and instruments growth will be steady...



Source: U.S. Department of Commerce; forecast: Cahners Economics

...thanks to these end markets



Instrument makers avoid repeat of '86 recession

The instruments and controls industry ended 1990 with its slowest annual sales growth in four years. U.S. factories shipped $53.2 billion worth of product last year, for an annual growth rate of 4%, down from 4.7% in 1989. Although modest, last year's gain compares favorably with the industry's anemic 0.6% growth rate during the 1986 slowdown.

At Cahners Economics, we expected the instruments market would reach its cyclical low point in its growth path at the end of 1990 before rising in early 1991. The recession has simply postponed an acceleration in shipments growth until the second quarter of this year. New orders rose just 2.9% in 1990, which will mean a weaker time for shipments in the first half of this year than we had originally predicted. We still expect the second half of 1991 to bring a rebound.

While the instruments market has slowed down, the current economic downturn cannot hold back the surging market for test and measurement equipment. According to New York consultants Frost & Sullivan, demand for test equipment is growing as the complexity of electronic devices increases 35% a year. The challenge for the instruments industry is to keep up with the aggressive pace of technology.

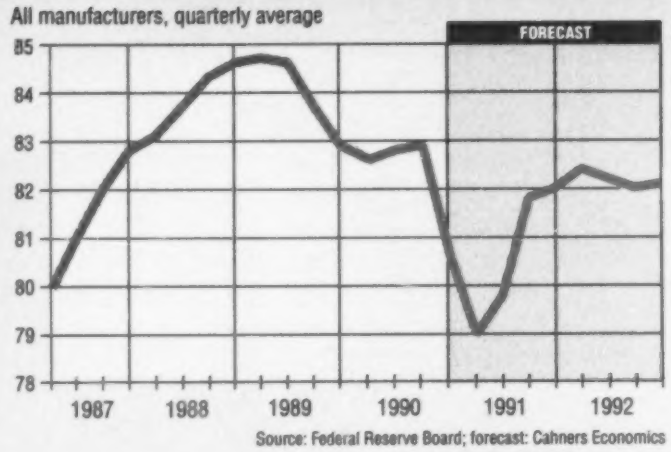
Consumption of test and measurement equipment will rise at a compounded annual rate of 9.6%, says Frost & Sullivan, from $5.68 billion in 1989 to nearly $9 billion in 1994. By end markets, industrial users bought $1.44 billion worth of test equipment and instruments, or 25% of the total in 1989. The next largest consumer, with a 19% share, was the military/aerospace industry.

Within the test market, automatic test equipment is expected to increase its share from 26% in 1989 to 27% in 1994. ATE will continue to gain importance as technology accelerates and demand for better quality grows. The ELECTRONIC BUSINESS ATE sales index was rebounding as 1990 ended. For the entire year, revenue for the ATE companies in the survey recorded a 2.9% rise over 1989, reversing the prior year's decline. Cahners Economics forecasts growth will continue rising with a 9.1% gain to $2.31 billion in sales this year.

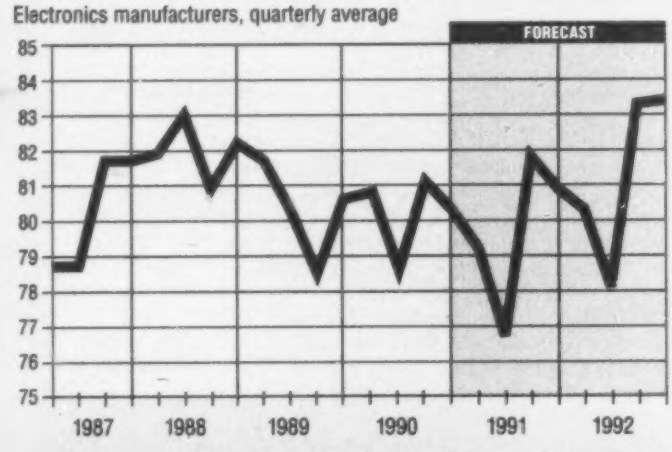
JOHN FARRELL

For more information on Cahners Economics' forecasting services, including seminars, newsletters, and database diskettes, contact Dan Buchan at (617) 630-2105; by fax at (617) 630-2100; or write Cahners Economics, Cahners Publishing Co., 275 Washington St., Newton, MA 02158

Until factory operating rates head back up...

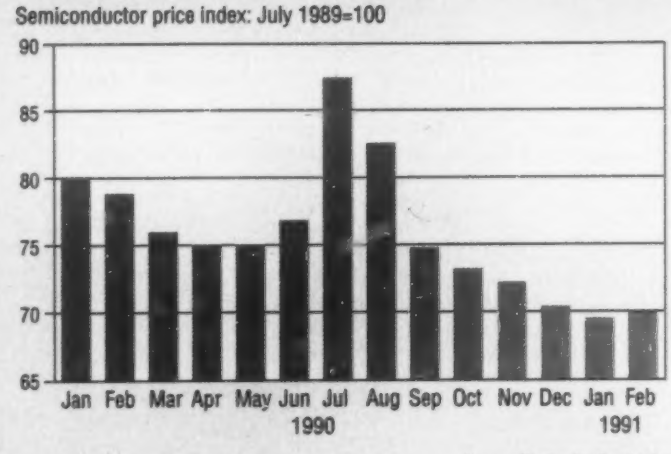


Source: Federal Reserve Board; forecast: Cahners Economics



Source: Electronics Purchasing; forecast: Cahners Economics

...manufacturers won't be raising prices



Source: Electronics Purchasing

Weak demand forces utilization rates lower

Capacity utilization is uniformly low across the economy because of reduced market demand during the current recession. From a utilization rate of 83% in July, all manufacturing capacity utilization plunged to 78.8% in January—the lowest level since September 1986. With capacity utilization rates below their long-term averages, manufacturers will be able to increase production to meet customer demand during the next rebound without creating inflationary pressures.

According to a survey of 500 buyers made by ELECTRONIC BUSINESS's sister publication, *Electronics Purchasing*, the electronics industry is also operating with excess capacity. The electronics plant operating rate stood at 77.9% in February, down from 80% recorded in February 1990. Cahners Economics expects capacity utilization in the electronics industry to average 80% this year and increase to an average of 81.3% in 1992 when the economy picks up speed again.

Falling capacity rates and weak demand have put pressure on manufacturers to lower prices—or at least to keep from raising prices. The National Association of Purchasing Management's price index tumbled to 41.8 in February, their lowest price index level since December 1982. For the electronics industry in particular, connector prices dropped for the third consecutive month, as did prices for memory chips, microprocessors, and printed circuit boards, says the NAPM. This was the third consecutive month that prices dropped for printed circuit boards.

According to *Electronics Purchasing's* transaction price survey, semiconductor prices held steady from January to February 1991. When compared with February 1990, however, semiconductor prices fell 11%. Electronics OEM purchasers confirm this trend; 66% of the respondents reported prices for the products they buy are steady, and 8% say prices are falling. Only 6% report rapidly rising prices, and 20% say prices are rising slowly.

With excess capacity and weak demand, expect price declines to continue in the electronics industry in the short run. Later, when demand and production rise with the rest of the economy in the second half of 1991, it will be time again for inflationary worries.

JULIE HANDELMAN